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same small box without special indication of locality; but the vertebræ are of precisely the same size sculpture, mineralization, and color as a large series whose locality is exactly known, to which they probably belong. Moreover, the jaws and vertebræ bear the same relation of size to each other in all three series. These facts render it highly probable that the remains are in each case rightly referred to the same animal. That no mixture has occurred is also probable from the fact that the large and small series (*Ichthyodectes* and *S. prognathus*) came from the same locality (Sheridan), while the species of intermediate size was discovered 160 miles from the mouth of the Solomon river, a long distance off. The pectoral spine, accompanying and belonging to the *S. prognathus*, I have shown to be the same as the *Xiphactinus* of Leidy, but probably not of the species *X. audax*.

The fourth series described above as *S. thaumas* exhibits precisely the vertebral characters of the two other species of *Saurocephalus*, and I cannot resist the evidence that it belongs to that genus or the same family. Its remains pertain to one animal, as asserted by Prof. Mudge, and their color and condition, coated with a chalky deposit of a ferruginous yellow color, lends great probability to the statement, to say nothing of more important reasons. No remains of pectoral spine are preserved; but instead, the remarkable segmented ray described. This comes from the posterior region of the vertebral column, and is, I believe, an anal spine, or the adjacent rays or compound ray forming the margin of the caudal fin. This finds support in the analogous structures already mentioned as occurring among Siluroids, etc., and the resemblance of the pectoral spine to the same weapon of the same group adds to the probability of the correctness of this conclusion.

These remarks are made because Prof. Agassiz, in the *Poissons Fossiles*, has referred several spines to the *Cestracant* genus, *Ptychodus*, which are very similar in character to that described above as the anal or caudal support of *Saurocephalus thaumas*. These were derived from the upper cretaceous chalk of Kent, England, where *Ptychodus* teeth also occur. The *Saurocephalus* teeth, described by Prof. Agassiz in the same work, were, however, derived from the same chalk and the same locality, and, from what has preceded, I believe the segmented spines should be referred to the latter genus rather than to *Ptychodus*. This is the more probable, in view of the fact that Prof. Mudge did not procure a single *Ptychodus* tooth during his exploration.

#### ON THE FISHES OF A FRESH WATER TERTIARY IN IDAHO, DISCOVERED BY CAPT. CLARENCE KING.

By E. D. COPE.

The materials on which the present account is based were placed in my hands by the Smithsonian Institution. They were obtained by Capt. Clarence King, on his expedition sent out by the Government, for the geological exploration of the fortieth parallel west of the Mississippi river.

As will be seen, the fossils described are evidently from a fresh water basin, once a lake, which has, at a comparatively late period of geological time, been elevated and desiccated.

The species and genera are chiefly cyprinidæ, and from the number of the former, ten, important as throwing light on the character of the forms of that family at a time not long preceding the establishment in their present habitations of those now living. Remarks on these relations are deferred to the close of the descriptions.

#### CYPRINIDÆ.

Characters of the genera represented :—

A. Pharyngeal tooth series transverse to longer axis of the pharyngeal bones.

Pharyngeal teeth 0.4—?.? with compressed roots, and probably molar or masticatory crowns on an oblique basis, the highest extremity being inferior, the lowest superior.

DIASTICHUS.

B. The pharyngeal tooth series very oblique to the longer axis of the pharyngeal bone.

Pharyngeal teeth 2.3(?4)—??. with round bases, and probably conic prehensile crowns ; no ala of the slender pharyngeal bones.

OLIGOBELUS.

C. The pharyngeal tooth series nearly in the longer axis of the pharyngeal bones.

Pharyngeal teeth 2.5—4.2 conic prehensile.

SEMOTILUS.

Pharyngeal teeth 0.5—?.?, with short, compressed crowns and narrow, transverse masticatory face, and no prehensile hook ; bone alate.

ANCHYBOPSIS.

Pharyngeal teeth 0.4—4.0, or the outer row 1 or 2 rudimental ; crowns molar, broad, truncate, with enamelled grinding surface.

MYLOCYPRINUS.

#### DIASTICHUS. Cope.

Genus novum.

DIASTICHUS MACRODON. Cope sp. nov.

Represented by three right pharyngeal bones, of which the distal extremities are lost. The proximal limb of the bone is long and flat, the extremity first dilated, then contracted coincidently with a transverse depression of the superior face, the end everted or expanded, with symphyseal surface within. There is no proper horizontal alar expanse, but rather an anterior one, the front face (inferior when on a plane surface), being a little oblique. Tooth series in the line of the axis of the superior limb of the pharyngeal bone, its base rising exteriorly and proximally. Outer face nearly vertical, grooved. The teeth are knocked off in all the specimens ; their bases are a broad, oval or parallelogram. The form of the crown is uncertain, but I suspect it to have been more or less truncate.

<i>Measurements.</i>	<i>M.</i>
Length proximal limb No. 1.....	0.027
Depth at base first tooth.....	.01
Width limb at middle.....	.008
Length limb No. 2.....	.017
Depth at first tooth.....	.0058
Length tooth series.....	.0135
Width third tooth basis.....	.005

These teeth indicate a species of about the size of the carp (*Cyprinus carpio*).

From Catharine's Creek, Idaho. Mus. no. 9792.

#### DIASTICHUS PARVIDENS. Cope sp. nov.

In this species the bases of the teeth are considerably smaller than in the last, and the proximal limb of the pharyngeal bone less depressed, and more cylindric. A section of the latter below the basis of the first tooth, is a triangle, the inner side a little shorter than the others. In the last species it is flat in that place.

	<i>M.</i>
Depth limb at first tooth.....	0.011
Width limb at middle tooth.....	.0065
Length tooth series.....	.014
Length basis third tooth.....	.0054

This species is represented by one pharyngeal bone of the right side, with the extremities incomplete, associated with many fragments of the cranium, etc. The size the same as that of *D. macrodon*.

No. 9782, Catharine's Creek, Idaho.

The peculiar arrangement of the tooth series in this genus, almost at right angles to that which is usual among Cyprinidæ, is not, so far as I know, shared by any recent genus of the family.

#### OLIGOBELUS. Cope.

##### Genus novum.

The direction of the dental series in this genus is intermediate between that seen in *Diastichus*, and the usual type. It resembles and exceeds the last described genus in the great elongation of the proximal limb of the pharyngeal bones, which are here considerably more curved. No bone of the genus preserves its distal end or its teeth complete. The bases of the teeth are round or oval, and not in close contact. It is scarcely likely that there were more than three in the outer row, though this is not certain. The proximal end of the series is abbreviated, as the first tooth of the index row is opposite its first, and the second opposite its second. The proximal end of the series is most elevated, but does not project beyond the lateral plane of the bone.

Should the outer series have embraced four teeth, a resemblance between the form of this bone and that of *Ericymba* and *Exoglossum* can be

traced. This genus will, however, be distinguished from those by the entire want of the lateral external ala common to these and other genera of Cyprinidæ. Two species are represented in Capt. King's collection.

OLIGOBELUS ARCIFERUS. Cope sp. nov.

Established on four right and one left pharyngeal bones, none of them with the distal extremity complete. The best preserved shows teeth 2. 3—, and there is no indication of space for a fourth, though its place of support is lost.

The proximal line is very strongly curved, and is long and slender. Its extremity is neither grooved nor recurved, but slender; its section would be a flat triangle, the inner face about equal to the outer. The size of the species equals that of *Diastichus macrodon*, the largest specimen exceeding any of the latter. It is probably the largest species obtained by Capt. King.

	M.
Length proximal limb No. 1.....	0.04
“ “ “ “ 2.....	.025
Depth near basis first tooth.....	.0065
Width “ “ .....	.0085
Length basis three outer teeth.....	.011
“ “ two inner “ .....	.007

Nos. 9782, 9791, Catharine's Creek, Idaho.

OLIGOBELUS LAMINATUS. Cope sp. nov.

Established on a left pharyngeal bone which lacks the distal extremity. It differs from the other species of the genus in its broad, flat proximal limb of this bone. Its section is not triangular, but that of a plate with a thin outer edge.

	M.
Width limb just below first tooth.....	0.008
Depth “ “ “ “ “ .....	.004

The expansion continues to near the proximal end.

No. 9791. Catharine's Creek, Idaho.

SEMOTILUS, RAFINESQUE.

I have referred to this existing North American genus two species of the present series, without being entirely certain that such reference will be finally adopted. It is based on the evidence of two pharyngeal bones of two species, one of the right and one of the left side, the former bearing four, the latter five teeth in the larger series. Should the series of the other bone of each prove to have the same number of teeth as the sides preserved, the species will be referable to two genera, the former 2.4-4.2 to *Ceratichthys*, the latter 2.5-5.2 to *Gobio*, both existing genera. To whichever of the three genera the species are referred, it remains to be one still in existence.

SEMOTILUS POSTICUS. Cope sp. nov.

Indicated by a left pharyngeal bone, of which the distal extremity has been broken away. The apices of the teeth of the exterior series are

broken away, those of the inner row are perfect. The bases of the former are cylindric, the latter are also cylindric, with conic crowns. Some fragments belonging to this or an allied species present conic proximal teeth, while specimens from other collections confirm the reference to *Semotilus*.

The expansion of the ala is very gradual, and projects anteriorly rather than outwards. Hence the outer face of the bone is one oblique plane from the bases of the teeth to the edge of the ala. The latter projects beyond the plane of the inner margin, so that the anterior face of the bone is oblique also. The external surface of the ala is cross-ribbed. The proximal limb of the bone is contracted, and slightly compressed near the teeth. Teeth 2.5—; the interspace between the inner pair, opposite the fourth of the outer series. The bases of the inner descend to the inner anterior margin of the base vertically.

<i>Measurements.</i>	<i>M.</i>
Length of tooth series.....	0.033
Depth at fourth tooth.....	.019
“ first “ .....	.011
Width “ “ .....	.0085
Length inner tooth.....	.011

This chub was larger than the common Eastern species, the *S. rhotheus*, the largest of the genus. The pharyngeal bone indicates a fish of five or six pounds weight. The gradual and slight expanse of the ala of this bone distinguishes the species from any of the existing ones. Named from the posterior direction of the teeth.

From St. Catharine's Creek, Idaho; obtained for Capt Clarence King by J. C. Schenk. Smithsonian, No. 1489.

*SEMOTILUS BAIRDII.* Cope.

Sp. nov.

This species differs from the last in the much less expansion of the external or alar margin of the pharyngeal bone. It has scarcely any alar prominence of the angle, which also projects so little beyond the inner margin as to render the anterior or perforated surface almost transverse. Distal end of the bone gently curved; proximal limb compressed near the teeth. Teeth 2.4—, those of the inner pair opposite the third and fourth of the outer series. Bases cylindric; crowns not preserved; outer face of the bone with numerous foramina penetrating it backwards.

<i>Measurements.</i>	<i>M.</i>
Length of tooth series.....	0.021
Depth at third tooth.....	.01
Width “ “ .....	.006
Depth at first “ .....	.008

From the same locality and explorer as the last species. No. 1482.

This species is dedicated to Prof. Spencer F. Baird, to whom the author is under greater obligations than to any other man, in respect to his special pursuits.

## ANCHYBOPSIS. Cope.

## Genus novum.

This form, characterized above, is nearly related to several now existing in the rivers of the United States, so far as the pharyngeal teeth serve as an indication. It is well known that they are more significant than any other part of the skeleton among the Cyprinidæ. They are arranged in one series of five on the right side, which rises and stands on a prominent basis superiorly, as in various genera, as *Stilbe*, most *Hybopses*, etc. This prominence is due to the abrupt incurvature of the superior limb of the bone. The crowns of the teeth are compressed, the grinding face truncate a little obliquely, and with a slightly concave transverse worm surface. Proximal limb small.

In *Hybopsis* the teeth are 4-4, but in *Hemitremia* Cope, 5-4, and quite similar to those of this genus. In *Hemitremia*, however, the lateral line is incomplete, and coincidence in this point is necessary for the reference of the present form to that genus. Imperfection of the lateral line is not known among the larger forms of true Cyprinidæ on this continent, and may not have existed in this genus. The principal ground of separation from *Hemitremia* is found in the transversely compressed and very short crown of the teeth; in the latter they are elongate and subcylindric. *Anchybopsis* is a more typically herbivorous form, and probably had much convoluted intestines, while in *Hybopsis* they are of the short carnivorous type.

## ANCHYBOPSIS LATUS. Cope.

## Spec. nov.

The only species of the genus. The pharyngeal bone expands rather abruptly into a prominent ala, without angular outline, and which soon turns into the outline of the superior limb. Surface of ala with transverse grooves to margin. Sizes of teeth 4, 3, 2, 5, 1, the first smallest, and with obtuse, subconic crown. Section of proximal limb at base of last, a triangle with truncate apex directed outwards. Teeth directed inwards; nutritious foramina on front of bone numerous and large.

<i>Measurements.</i>	<i>M.</i>
Length tooth series.....	0.026
“ third tooth .....	.011
Long diameter crown tooth.....	.0075
Width bone at third tooth (exterior).....	.016
“ “ “ (anterior).....	.016
“ “ first tooth (exterior).....	.006

## MYLOCYPRINUS. Leidy.

Proceedings Academy Natural Sciences. Philadelphia, 1870, p. 70.

This genus, named by Leidy, as above, had been noticed by Dr. J. S. Newberry\* as allied to *Mylochilus*, Agass. Leidy compares it to the carp and other Cyprinoids. Its affinities are apparently between Mylo-

\* In Proceedings New York Lyceum Natural History, 1870. Copied into Nature, 1870, p. 335.

chilus and Cyprinus; though it has fewer teeth than either, its formula 4—4 or 2.4—4.2, being that of the majority of the existing American genera. According to Agassiz, the first-named displays 2.2.5—5.2.3 etc.; while in the latter they are 1.1.3—3.1.1, and have concentrically sulcate grinding surfaces. In the present genus, these surfaces are smooth, except where excavated by use. The inner series is represented by two rudimental teeth, which are often wanting.

In describing the pharyngeal bones which belong to this genus, Leidy commits the error of inverting them, calling the inferior extremity the superior, etc. The symphyseal articulation of the bones he then regards as designed for articulation with the cranium, a structure which, it is needless to observe, has no existence in this division of fishes.

Among the numerous specimens brought by Capt. King, I recognize at least three species, as follows:—

MYLOCYPRINUS ROBUSTUS. Leidy.

L. c.

Teeth rapidly diminishing in size upwards, the last with crown from one-fourth to one-sixth the area of that of the first, and standing on an elevated base which projects upwards. Alar margin expanding very gradually, its greatest expansion generally below opposite to the basis of the first tooth, and considerably contracted opposite to the last tooth. The superior limb short, flat, abruptly incurved.

Eleven specimens, of which six belong to the left side. They vary in the outline of the basis of the teeth; in most, it is quite straight, in others curved; and, as a consequence, in these the superior part does not form such a prominent buttress as in the first. A large species. Greatest length of longest bone, 0.046 M.

No. 9792, Catharine's Creek, Idaho.

A single right pharyngeal of large size may indicate another species. The tooth series is curved, and the first tooth unusually small. The principal peculiarity is seen in the superior limb, which is long, slender, and transverse, with a median contraction, and less flattening than in the other specimens. Locality the same.

MYLOCYPRINUS KINGII. Cope.

Spec. nov.

This is represented by a single right pharyngeal bone of large size, and is distinguished by peculiarity in the character of its teeth. These, instead of diminishing in size upwards, increase, so that the fourth tooth is larger than the first, instead of one-fifth the size as in *M. robustus*. The second and third are intermediate in proportions. The crowns are broad, transverse ovals. The proximal limb of the bone is short, and gradually expands into the ala, whose greatest width is opposite the second tooth. The superior limb is short, narrow, and incurved. A trace of basis for a small tooth of an inner series.



<i>Measurements.</i>	<i>M.</i>
Greatest length of bone.....	0.046
“ “ dental series.....	0.020
Transverse diameter first tooth.....	.008
“ “ third tooth.....	.009
“ “ fourth tooth.....	.008
Width bone at second tooth (exterior).....	.017
“ “ “ (anterior).....	.018
Length proximal limb.....	.02

From the same locality as the last. Dedicated to Capt. Clarence King, to whom science is indebted for the survey of the fortieth parallel, and the palaeontological discoveries incidental to it.

#### MYLOCYPRINUS LONGIDENS. Cope.

This third species of the genus is represented by one right pharyngeal bone bearing the upper three teeth. It is quite distinct from the species already named, in several points. The ala commences by an abrupt expansion opposite to the middle of the first tooth, instead of by a gradual widening of the proximal limb. Hence, in this species the latter is more slender than in the others. Next, the teeth are of nearly equal size, the transverse diameter of the three being about equal, though the last is rather flatter than the others. Thirdly, the teeth are more slender, the length of the shanks being much greater than the long diameters of the crowns; these measurements are nearly equal in the other species. Lastly, the type of the present species is scarcely half the size of the most numerous individuals of the *M. robustus* and *M. kingii*. The basis of the tooth series rises obliquely backwards, as in *M. robustus*, and within it are the bases of two small teeth of the inner row, better developed than in that species. The diameters of the second and third teeth are equal.

<i>Measurements.</i>	<i>M.</i>
Greatest length right pharyngeal.....	0.029
“ “ tooth series.....	.018
“ “ proximal limb.....	.012
Elevation second tooth.....	.007
Transverse diameter crown.....	.0048
Width bone at crown (exterior).....	.0115
“ “ “ (anterior).....	.013

From Catharine's Creek, Idaho, No. 9192. Capt. King's Expedition. Collected by J. C. Schenk.

#### SALMONIDÆ.

##### RHABDOFARIO. Cope.

Genus novum.

Teeth on the maxillary and mandibular arches large, numerous; teeth on the vomer, glossohyal, and palatine bones, also well developed. Teeth with hollow crowns and plicate dentine, which is ribbed on the pulp cavity, and grooved externally. Muzzle and mandible sub-equal. Max-

illary bone much prolonged, sub-cylindric, but little compressed distally, bearing reduced teeth near its extremity. Preorbital bone short, sub-orbital narrow. Inferior basihyals as deep as long.

This genus is nearly allied to *Salmo*. With no other portions of the animal than the cranial bones, the only difference I discover is in the form of the maxillary bones, which are subcylindric or rod-like, instead of flat or laminiform, as in *Salmo*. At the extremity, though flat, they are still narrow, and I do not find surface of attachment for the supernumerary bone of *Salmo*.

#### RHABDOFARIO LACUSTRIS. Cope.

##### Species nova.

This fish is represented by a large part of the cranium, including all anterior to the middle of the orbits above, to the metapterygoid medially, and to the posterior part of the dentary below. Both dentaries remain, but the premaxillary and maxillary of one side only are preserved. There are separate portions of the maxillary bone, of four other individuals, and mandibular and palatine of one. These indicate a salmon of the average size of the migratory marine species, *Salmo salar*.

The cranium has been compressed, but apparently not depressed, so that the plane of the muzzle from the frontal bones is perhaps nearly preserved. In its present condition the profile descends very gradually, and the muzzle has an acuminate form. The frontals are ornamented by numerous grooves which radiate anteriorly, and are more numerous medially. The premaxillaries are subvertical, or roof shaped, and their broad lateral face is prolonged well backwards—to opposite the fifth mandibular tooth. The distal part of the maxillary and the dentary are striate-grooved, the latter obliquely downwards. The extremities of the dentaries are rugose, and emarginate in profile. They are not produced or recurved at the symphysis, and the latter is not coössified in the specimen. The anterior extremity of the premaxillary is lost, but the remaining portion supports five teeth. There are seventeen on the part of the maxillary preserved, three in 0 M.01. There are 14–15 on the dentary, two in 0 M.01. The palatine, vomerine and the glossohyal teeth are a little smaller than the dentaries, and more as the maxillaries. All the teeth have swollen bases, with a plurodont attachment. The crowns are cylindric, acute, and on the lateral bones, incurved.

<i>Measurements.</i>	<i>M.</i>
Length of the tooth series of the dentary..	0.092
Depth of symphysis.....	.018
Depth pterygoid and palatine at last mandibular tooth....	.027
Depth premaxillary at middle.....	.018
Length crown of a mandibular tooth.....	.008
Width of half frontal bone at nares.....	.014
“ suborbital.....	.0085

The preorbital region is occupied by a bone somewhat T-shaped, the vertical limb spatulate, directed downwards and forwards, with grooved margins. Suborbital with rough marginal face.

This specimen was found by J. C. Schenk for Capt. Clarence King, at Castle Creek, Idaho. No. 9790 Smithsonian Collections. The other specimens are from Catharine's Creek, Idaho; Nos. 9785—9786. A portion of a maxillary of one of these forms indicates a fish half as large again as the one above described.

#### GENERAL OBSERVATIONS.

The six genera of fishes above described, present interesting relations to existing ones. One of them, *Semotilus*, is recent, while three are closely allied to existing genera; viz.: *Rhabdofario*, *Anchybopsis*, and *Oligobelus*. *Distichus* and *Mylocyprinus* are less nearly related to living genera. The five representing the Cyprinidæ can be referred to the groups into which the existing members of the family fall; thus *Semotilus* and *Oligobelus* are carnivorous, and *Anchybopsis* and *Mylocyprinus* herbivorous and molluscivorous. Accompanying these fossils are three species of the recent genus *Astacus*, (*A. subgrundialis*, etc.) which I describe in the Proceedings of the American Entomological Society for 1870.

The molluscs of this formation have already been described by F. B. Meek, and they, like the fishes, determine it to be lacustrine and fresh, as already stated by Prof. Newberry. The species are stated by Meek\* to be distinct specifically, and in some cases generically, from all others hitherto described from the West. Leidy observes,† that Mammalian Remains received from Capt. King's expedition include portions of *Mastodon mirificus* and *Equus excelsus*, which indicate an age similar to that of the bad lands of the Niobrara, which Hayden calls Pliocene.

The remains described in this paper furnish few means of determining the age of the deposit. There is, however, a great probability of their being later than Miocene, and nothing to conflict with their determination as of Pliocene age.

It may be added that numerous portions of skeletons of fishes remain to be identified, in Capt. King's collection

#### ON THE ADOCIDÆ.

BY E. D. COPE.

#### ADOCUS. Cope.

Proceed. Acad. Nat. Sci., Phila., 1868, 235. Proceed. Amer. Philos. Soc., 1870, 295; Transac. Am. Phil. Soc., 1869, 232.

Additional material enables me to add important characters to this genus, and to define its position with something like precision.

In the first place I find that it possesses a large intergular plate. This I have verified on *A. beatus* and *A. syntheticus*, sp. nov. Having also perfect xiphisternal bones of these two species, I can show that there is no sutural attachment for the pelvic bones. The coexistence of these two characters has been hitherto universal, and the present deviation from it is a point of much interest. Instead of sutural surfaces, there

\* Proc. Acad. Nat. Sci., Phila., 1870, 56.

† l. c. 1870, 67.